

LINEAR CLASSIFIERS

Linear classifiers are an important subclass of classification models. If the discriminant function(s) $f_k(\mathbf{x})$ can be specified as linear function(s) (possibly through a rank-preserving, monotone transformation $g: \mathbb{R} \rightarrow \mathbb{R}$), i. e.

$$g(f_k(\mathbf{x})) = \mathbf{w}_k^\top \mathbf{x} + b_k,$$

we will call the classifier a **linear classifier**.



NB: \mathbf{w}_k and b_k do not directly refer to the parameters θ_k of k -th scoring function f_k but the transformed version.

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We can also easily show that the decision boundary between classes i and j is a hyperplane. For every \mathbf{x} where there is a tie in scores:

$$f_i(\mathbf{x}) = f_j(\mathbf{x})$$

$$g(f_i(\mathbf{x})) = g(f_j(\mathbf{x}))$$

$$\mathbf{w}_i^\top \mathbf{x} + b_i = \mathbf{w}_j^\top \mathbf{x} + b_j$$

$$(\mathbf{w}_i - \mathbf{w}_j)^\top \mathbf{x} + (b_i - b_j) = 0$$

This is a **hyperplane** separating two classes.

